THE

Malayan Agricultural Journal.

Vol. XIII.] MAY, 1925. [No. 5.

PRELIMINARY NOTES ON MANILA HEMP.

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THE object of this article is to place on record the results which have been obtained in the Department of Agriculture during the examination of some fibres taken from plants of *Musa textilis* supplied from the Experimental Plantation, Serdang and the Department of Agriculture, Sarawak; also to compare the above mentioned results with those obtained by making similar tests on standard samples of Abaca Fibre received from the Bureau of Agriculture, Phillippine Islands.

It is not possible at present to give any information with regard to the yield of Manila Hemp per acre under Malayan conditions or other factors essential to the economics of the crop, but investigations are being continued in the Department of Agriculture and further results will enable conclusions to be drawn as to the suitability of Malayan conditions for the profitable cultivation of Musa textilis.

It is intended here to give a brief survey of the information that is available as to the Abaca Fibre industry in the Philippine Islands together with the results which have been obtained at the Department of Agriculture from the examination of samples of fibre prepared under standard conditions. The experience gained from experimental cultivations in British North Borneo is also available for record and a summary of the results is set forth in comparison with the results already obtained at the Government Experimental Plantation, Serdang.

Abaca Fibre in the Philippine Islands.

The term "Manila Hemp" or "Manila" is no longer used in the Philippines, the Spanish-Philippino term "Abaca" or "Abaca Fibre" is always empleyed there and from correspondence with the United States Department of Agriculture it appears that the term "Abaca" is a more accurate designation of the product.

The Director of Agriculture, Bureau of Agriculture, Philippine Islands in his Annual report for 1923 when writing of Abaca stated

" This crop, the fibre par excellence in the world, which declined considerably in its production after the signing of the Armistice because of a glutted market, was restored this year to its former rank, the largest production ever known in the Islands having been recorded. During the decade prior to the signing of the Armistice the annual production of Abaca was 2,468,090 piculs and the largest crop known was for 1911, which was 2,717,460 piculs. This year the production was 2,986.386 piculs, which was 21% larger than the 10 year average of 1910-19, 10% larger than the record crop for 1911 and twice as much as last year's crop.

" This excellent result obtained by the farmers despite their difficulties in securing sufficient labour was realised because of the big demands this year for abaca fibre in the world's markets and a proportional rise in the prices commanded, from *P=10.41 per picul last year to 13 16 this year. This price was P 1.33 higher than that normally prevailing before the war."

Climate and Soil.—Abaca requires an evenly distributed rainfall, a tropical climate and the absence of heavy winds. The plant is a native of the tropics, but it is stated that excessive heat isdetrimental to the quality of the fibre, possibly owing to increased transpiration. The plant has been found to flourish up to a height of 3000 ft. above sea level. On account of the large leaf surface the crop cannot be successfully cultivated in a situation subject to heavy winds, for many of the plants would be blown down, especially in young areas, where the intervals between the plants are comparatively great.

The two main soil conditions required are a plentiful supply of natural food material and good drainage.

The soil must be fertile since it is the normal practice to plant an area with abaca fibre and to harvest that area for approximately fifteen years without any manure or rotation of crops. This is a heavy drain on the soil with a crop like abaca, which involves the removal of a large amount of organic matter when the stems are taken to the factory for preparation, especially when one realises that the stools are only 8—10 ft. apart and that each stool may yield as many as three stems every four months.

The second point with regard to drainage will be discussed in connection with results obtained at the Government Experimental Plantation, Serdang.

The type of soil is important as it has been shown that *Musa textilis* is a surface feeder and that roots growing in a heavy or close grained soil do not develop so well as those growing in a more open soil From the experience gained by the College of Agriculture, Los Banos, it is shown that a deep sandy loam is the most desirable, but some varities of abaca are known which are capable of producing satisfactory crops under heavier soil conditions. The " Tangongon "

* Straits Currency $1 equivalent to P 1.4 Manila currency.

variety of abaca fibre grows in a heavy clay soil and is resistant to drought, and it appears, from the literature on the subject, that systematic breeding would enable the production of varieties suitable for an extensive range of soil and rainfall.

Botanical.—Manila Hemp or Abaca fibre is obtained from *Musa textilis*, which belongs to the Natural Order Scitamineae. All species of Musa, i.e. the wild and cultivated bananas, contain a fibre but only the fibre from *M. textilis* has a commercial value, the other species yield a comparatively low proportion of an inferior fibre*

The plant is a tree-like herb, reaching under ideal conditions an overall height of 33 ft., the part commonly referred to as the stem is really a pseudo-stem consisting originally of the bases of the closely packed leaf sheaths which grow from the fleshy root stock, it is cylindrical, and when mature up to 20 ft. in length.

The leaves are oblong, somewhat pointed at the ends, rather smaller and firmer than other species of Musa, a bright green on the upper side and somewhat glabrous below. When the plant is nearing maturity the flowering stalk is pushed up through the centre of the leaf sheaths from the root. The flowers are first enclosed in a cone, each cluster of flowers being covered by a firm brownish bract. The first bracts which open contain the female flowers, from which the fruits are formed, the outer bracts only contain male flowers. The fruit is green, about two and a half inches long and up to one inch in diameter, the section of which is roughly a triangle with convex sides. The seeds are black, about 1/6 inch in diameter, somewhat flattened. The fruits are not edible. The plant may be propagated from seed, suckers or by division of the root stock.

Planting suckers is the method usually employed in establishing *Musa textilis*. At the base of the parent, suckers are freely produced and they can be removed without interfering with the further growth of the plant. The method next in favour is that of dividing the root-stock, the disadvantage being that the entire parent, must be removed and consequently the method is not economical unless it is desired to replant an area.

Propagation by seed is a slow and expensive method only of interest in connection with the breeding of new varieties or if it is desired to increase the number of plants by every available means.

Harvesting.– The first stems should be ready for harvesting, between $1\frac{3}{4}$--2 years after planting, by which time the stool should consist of from twelve to twenty-five stems.

The stems should be cut just before or as soon as the flowering stalk appears, and as close to the ground as possible. Care must be

*Samples of "Wild Pisang" (*Musa sp.*) from Frasers Hill, Pahang, yield approximately one per cent of a weak fibre. Samples from Carey Island, Selangor, had a somewhat better tensile strength, the yield being unknown. In both cases the colour was poor.

taken to see that a sloping cut is made, otherwise rain will collect on the cut surface and cause rot to start which will injure the root stock and the remaining plants in the stool.

Method of preparation.—In order to obtain the best results, it is imperative that the fibre should be extracted as soon as possible after the plants have been cut.

The first process in stripping consists of removing from the back of the outer sheath, with the aid of sharp bone (called in the Philippines a "*Locnit*") two to four strips of fibrous material 2 or 3 inches wide, each strip being the whole length of the sheath. The remaining part of the sheath is then removed and each successive sheath is dealt with until the central flowering stalk is reached. These strips are usually separated into two grades, according to colour, to facilitate the final grading of the fibre.

This work is usually done in the field to avoid the transport of large quantities of material to the central stripping shed. In the central stripping shed the pulpy part of the strips is removed from the fibre with the aid of a simple machine called "*Panguijan*" or "*Jayutan*". This machine consists of a log of convenient height, on top of which is fastened a block of smooth hard wood. Above this block a blunt knife with a handle is fastened by means of a pin at the base of the blade. The end of the handle is connected to a bamboo above and a foot treadle below, by means of pieces of rotan. The bamboo is so arranged that it forms a spring which keeps the knife firmly down on the block of hard wood when the machine is in use. The foot treadle is used by the operator to lift the knife from the block when he wishes to insert a fresh strip of leaf-sheath. The amount of pressure exerted on the knife is adjusted by means of altering the length of the rotan from the knife handle to the bamboo.

The method of extraction is for the operator to raise the knife, by means of the foot treadle, and then place one or more strips of leaf-sheath under the knife, the foot is then taken off the treadle and the knife is pressed down on the block by the action of the bamboo spring. The strip is then pulled through by the operator and this removes all the pulp from the fibres; the strip is then reversed and the pulp from the part previously held in the operator's hand is removed as before.

The fibre thus produced is sorted into two grades and then hung on poles in the sun to dry.

Although the above operations appear simple, care must be taken to see that they are properly performed as the way in which this work is done controls the quality of the fibre produced. If the knife edge is not smooth or the pressure is insufficient, some of the pulp will be left on the fibres; if the pressure is excessive an undue amount of fibre will be wasted and the operator will lose that proportion of his day's production.

Examination of Manila Hemp.—The Abaca fibre grown in the Philippine Islands is subjected to an official grading before being

placed on the market. The standards adopted serve as criteria for classfying the whole of the word's supply of Manila Hemp, thus it is relevant to record here the designations of grades and types established by the Philippine Islands Government Grading Stations.

The characteristics of a fibre which affect its grade are :—

Tensile strength.
Colour.
Extent of cleaning.
Texture.
Length.

Tensile Strength.—This is a basic quality and any fibre must possess an average normal breaking strength in order that it may be graded to any of the established standards, otherwise the fibre will be graded as "damaged," irrespective of its colour or cleaning.

Colour.—The tensile strength of a fibre being good the practical grading of a "lot" or "parcel" will be based on its colour. The colour ranges from brown or purple to white. Classification is made by comparison with standards. The superior grades are practically milk white. The fibre graded as "Current," which comprises the bulk of the world's supply, is white with a few traces of light brown.

Extent of Cleaning.—The method of cleaning often produces radical changes in the character and usefulness of the fibre hence the establishment of a separate set of standard grades for abaca strips. In describing the cleaning of fibre the following terms are used:—

"Excellent" when the cleaning is perfect and the product is pure fibre. Material of this description is prepared for tagal braid or other fine textile purposes.

"Good" when the cleaning is slightly imperfect and the product does not wholly consist of separated fibres, but contains strips. These strips are however fine and soft.

"Fair" when the product is distinctly coarse and contains a large proportion of strips.

"Coarse" when the product is wholly composed of strips which are wide and contain appreciable proportions of adhering vegetable pulp.

Texture.—The texture of Manila Hemp varies in most cases accerding to its cleaning but the variety of the plant fron which the fibre is stripped has also an important influence. Some varieties of abaca grown in North and South Mindanao are said to produce medium or hard texture fibres although they are excellently cleaned.

Length.—Abaca fibre is designated "very long" when it exceeds 10 feet ; "long" when it is 8 to 10 feet ; "normal" when it is 5 to 8 feet and "short" when it is under 5 feet.

Manila Hemp Obtained from the Director of Agriculture, British North Borneo.

Samples of fibre from *Musa textilis* grown on the Tawan-Kuhara Estate, Tawan, British North Borneo were received at the Department of Agriculture, F.M.S., in May 1924. Similar samples had already been examined by the United States Department of Agriculture, Bureau of Plant Industry, Washington, and had been described as excellent. The tests conducted in Kuala Lumpur gave results which were decidedly below those recorded in Washington and were considered to be inferior to the standard accepted for "Fair current" Manila Hemp.

Further samples of fibre grown on Tawan-Kuhara Estate were submitted for examination in March, 1925. The results obtained on these samples are recorded in Tables I and II.

The letter from the Director of Agriculture, Sandakan covering the fibre submitted in March furnishes the following information relative to the preparation of Manila Hemp in Borneo:—*

"The extraction of fibre commenced within 48 hours after the cutting of the stalks. Precaution should be taken that it does not take longer than this otherwise the fibres are liable to become discoloured and weaker and the stalks will lose some of their sheaths from decaying and drying. The fibres were obtained from the outer portion of the sheaths.

The process of fibre extraction consisted of two distinct operations, first, the removal of the ribbon-like strips of fibrous material from the leaf-sheaths and second, the separation of the individual fibres by pulling these ribbons under a knife.

The labourer sitting on the ground with a stalk of abaca across his knee inserts under the bark of one of the leaf-stems, near the base, a small sharp piece of wood called, "Locnet" and pulls off a strip about 3 inches wide and as long as the stalk. One sheath yields 3 strips. When the strips have been taken off, the remaining fleshy portion is removed and consecutive sheaths stripped down to the central portion of the stalk."

The stripping apparatus used at Sandakan, is very similar to that generally used in the Philippine Islands, so that a detailed description is unnecessary.

"*Factors Influencing the Production of Good Quality Fibre.*"*

1. Extracting knife.

Many abaca planters prefer to use the serrated rather than the ordinary knife in extracting fibre.

*Notes on the preparation of fibre at the Experimental Gardens Sandakan. reference A.C. 76/25. (3).

2. Time of Extracting the Fibre.

Fibres should be extracted soon after the stalks are cut, otherwise many of the fibres become discoloured and weak.

3. Variety.

Different varieties of abaca produce different qualities of fibre. *Bongolanon* produces coarse and dull fibre, while *Libuton* produces fine and white fibre.

4. Age of the plants.

Fibre extracted from too old or too young plants is weak.

The extraction of fibre should commence just at the beginning of the flowering stage of the plants.

5. Only the fibres of the leaf-sheaths in the middle portion of of the stalk are extracted. The fibre in the outermost 4 or 5 leaf sheaths are weak, due, according to certain authorities, to the presence of silica in the fibre cell wall. The fibre in the innermost leaf-sheaths, on the other hand, are white but also weak."

The correspondence shows that the fibre produced on Tawan Kuhara Estate was grown on a soil of volcanic origin and that as far as can be judged at present the fibre produced from *Musa textilis* grown on soil which is not of volcanic origin gives inferior results. At the present time no conclusive facts are available for publication.

Manila Hemp at the Government Experimental Plantation, Serdang.

The area under Manila Hemp at Serdang is approximately 13 acres, made up of a block 3 acres (approx) planted during the last quarter of 1922 and the first quarter of 1923, also a block of 10 acres planted during the latter half of last year. This article deals with the product of the 3 acre block.

The plants growing at Serdang are the offspring of a few suckers received from the Bureau of Agriculture, Philippine Islands during September, 1909. The original suckers were planted at the Government Experimental Plantation, Kuala Lumpur, and a small plot was maintained there, till the block had been selected at Serdang.

The area is flat, and the soil shows a great variation, especially when one considers the size of the area. A portion of the area is practically pure sand, and the balance is a peaty loam, except fer a small strip of almost pure peat at one end. This strip of peat was flooded by an adjoining spring before being drained.

The soil conditions are not ideal; the sole reason for planting the block in question was to raise a stock of planting material for an experiment on a large scale.

The area is well drained ; one of the plantation main drains runs along the north and part of the east side and there is a drain across the western end which taps the water from the abovementioned spring.

Cultivation – The area was felled, burnt and stumped at the end of 1921. Previous to planting the land was ploughed with a tractor and a double furrow plough. The suckers were planted 10ft. x 10ft. square, in holes 2 ft. x 2 ft. x 2 ft. Immediately before planting the holes were filled in with surface soil taken from the vicinity, in this surface soil a small hole was dug just large enough to take the roots, the sucker was then placed in the hole and the soil well trodden down round it. The planting of the area was spread over a long period, as it was not possible to obtain sufficient suckers of suitable size at any one time.

Shortly after the planting of the crop was commenced *Tephrosia candida* was sown as a cover crop. Two rows of *Tephrosia* were sown between the rows of Manila Hemp north to south, each row of cover being 3ft away from the crop. The cover was allowed to grow up till October, 1921, when it was pruned to 3 feet in height and 1 foot in breadth.

It is of interest to note that a few seedlings have been successfully raised at Serdang, and the seedling plants are in every respect as strong as plants of the same age grown from suckers. It is hoped to raise more seedlings, at an early date, as there are now several " tandens" of fruit nearly ripe.

In the event of a reasonable percentage of seed germinating, it should be possible to breed varieties particularly suited to this country if it is found by further experiments that the local conditions, particularly with regard to climate and soil, are suitable for the economic production of Manila Hemp. When the plants were cut the appearance af the block could only be described as fair. Our observations show that the soil is apparently unsuitable for the cultivation of Manila hemp, as the stems of the great majority of the plants are less than 3 feet in height, although they are now two years old and some of the plants have produced poor fruits and died without attaining a height of 3 feet, indicating clearly that the soil in question does not contain sufficient nourishment. Even on the peaty loam the growth has not been good, as only one third of the plants have stems exceeding 3 feet in height. The tallest stem yet grown was only six feet in height, while in the Philippine Islands 8 feet is recorded as the minimum for a stalk. It is possible however that the inferiority of the crop may be caused by the irregularity of the rainfall at Serdang as well as the unsuitability of the soil.

In a note on Manila hemp in the Kew Bulletin 1895 it is stated that " Anything " less than a well distributed rainfall of four or five inches per month will stop their growth." The rainfall records at Serdang show that during the months of July, 1923 and June and July, 192 , the total rainfall for the month was less than four inches. This short dry spell may be partly responsible for the poor growth.

Pests and Diseases.—The following note on insect pests of manila hemp grown in Malaya has been supplied by Mr. B. A. R. Gater, Ag. Government Entomologist.

"Manila hemp being nearly related to the banana plant all insects which attack the latter may be expected to damage it, such attacks being relatively more serious if the hemp is planted on a large scale. Conversely Manila hemp would serve as a reservoir for banana pests, and its importation into the Philippines, together with other species of *Musa*, is prohibited for this reason.

The pests so far recorded on Manila hemp in Malaya are few, the only one which need be mentioned being the Banana Skipper (*Erionotathrax*, L.) which rolls portions of the leaves. *Cosmopolites sordidus*, Germ., a weevil which attacks the base of the stem, is a serious pest in the Philipines, and is at present on bananas in this country.

On the whole bananas in Malaya suffer little damage from insects so that it may be assumed that manila hemp will not be attacked to any great extent. In addition to those mentioned above, the only other banana pest which might become serious to both plants is the weevil *Odoiporus longicollis*, Oliv. Some of the common grasshoppers might develop locally and cause some trouble."

A note by Mr. A. Sharples the Government Mycologist contains the following information.

"The diseases of Manila Hemp *Musa textilis* do not appear to have been closely investigated, but this crop appears to be affected to some degree with diseases similar to those affecting its close relative, the Banana (*Musa sapientum*). The following passages are taken from various numbers of "The Review of Applied Mycology."

"Heart rot" of *Musa textilis*, similar to that of Banana, is due to a fungus not yet described, and causes a continuous slight reduction in the total annual production of Manila Hemp, (in the Philippines). A root rot that follows the attacks of the root borer (*Cosmopolites sp.*) is mentioned, while another root rot, associated with a species of *Marasmius* and apparently not previously reported, occurs occasionally. Leaf spot diseases of slight importance also have been observed.

"Bunchy Top" plantain disease was reported as destroying a plot of Manila Hemp at Peradeniya Experiment Station in 1918. The cause of this disease has not been definitely ascertained. Nematodes sometimes occur in the living portions of the roots, but they are not invariably associated with the disease, so that it is improbable that they produce it. *Rhizoctonia* is prevalent on both the finer and larger roots, but the evidence is insufficient to connect the disease definitely with the presence of this fungus."

Method of Extraction.--The stems were cut in the manner described under a previous heading " Manila Hemp in the Philippine Islands."

The plant stems produced at the Experimental Plantation Serdang were stripped of their foliage and trimmed at the base. The cut stems were weighed and then stood in water to wash the cut sections which had come in contact with the knife. Care was taken to handle the stems as rapidly as possible after cutting. The leaf sheaths were subsequently removed by hand and immediately decorticated.

In the first trials the decortication was carried out on a raspador machine as used for Sisal Hemp and similar material, but it was found that the finished fibre, although satisfactory in other respects, had a very inferior grey mottled colour. In subsequent trials therefore the fibre was extracted from the separated leaf sheaths by the use of a small hand machine which is constructed on the same lines as the machines used in the Philippine Islands by the native small-holders. It should be possible to construct a suitable apparatus of this type out of a hard wood and thus avoid any contact with iron or steel during the preparation of the fibre.

The vegetable juices occurring in the stem of the plant readily change colour in contact with the air, this change is accentuated in the presence of iron or steel with the result that the fibre is stained a dull brown colour which cannot be removed by subsequent washing. Our experience with the preparation of Manila Hemp leads us to conclude that the actual decortication and winning of the fibre is a compartively easy operation and can be carried out readily with a simple and inexpensive machine, but unless particular care is taken to avoid the fibre being stained by the natural juices, after they have come in contact with air, the resulting sample will have a brown colour and therefore can only be disposed of as lower grade material.

In this connection it is interesting to note that there does not appear to be any material difference in the tensile strengths of the brown fibres and the white fibres, and results published by the Bureau of Agriculture, Philippine Islands confirm this observation.

The valuation of Manila Hemp depends largely on the appearance of the finished fibre and our experimental work has shown that the rapid stripping and drying of the fibre is essential in the preparation of a sample with average standard appearance. It has not yet been possible to produce a fibre at the Department of Agriculture, F.M.S. & S.S. better than that submitted by the Director of Agriculture, Philippine Islands as " current " Government Grade E. It is not known whether this is entirely due to inefficient methods of preparation or to the inherent characteristics of the variety of *Musa textilis* being grown at the Government Experimental Plantation, Serdang. According to observations on forty seven varieties of abaca grown under Los Banos conditions, the textune of the fibre is a character depending on the variety of the plant. Whereas the colour and

strength of the fibre depend upon the position of the leaf sheath. This is confirmed by the results obtained from the examination of the samples of fibre from Sandakan.

Examination of Fibre.— The banks of fibre when dried at room temperature were sampled in accordance with the established practice of the Philippine Islands Government and subjected to a chemical examination as well as breaking strain tests.

For convenience in comparing the results obtained on the Serdang fibre with the results obtained on the British North Borneo, and the Manila fibre, the figures for all samples are recorded together. (See Tables I, page 136 and II, page 138.)

COMPARATIVE RESULTS OF EXAMINATION OF SAMPLES OF MANILA HEMP AT THE DEPARTMENT OF AGRICULTURE, KUALA LUMPUR.

Description of Samples.—1. Sample from Manila "Extra Prime." Colour absolutely white with a good lustre, cleaning "Excellent," texture "Soft and silky"; length "Normal"; This fibre is obtained from the interior sheaths around the core of the abaca stalk.

2. Sample from Manila. "Superior Current." Colour a light ivory yellow and portions quite white, with a good lustre. Cleaning "Excellent;" texture "Soft"; and length "Normal"; the majority of it being used for the manufacture of ladies' hats and some woven fabrics.

This grade can be regarded as the highest used for cordage purposes.

3. Sample from Manila "Good Current". The predominant colour is a very light golden brown though much is yellow to white. Cleaning "Good"; texture "Soft to Medium"; length "Normal" to "Long."

This grade may be regarded as the lowest of the superior grades and is the fibre most extensively used in the manufacture of marine cordage and high grade ropes.

4. Sample from British North Borneo. Labelled B. Received March 1925. "Extracted from the leaf stalks between the outer and inner leaves, representing the great bulk of the fibre." The fibre is equivalent in colour to "Current" Manila Hemp. Cleaning "Good", texture "Soft"; length "Long."

5. Sample from British North Borneo. Labelled C. Received March, 1925. "Extracted from the short stalks near the outer edge of the stem. The colour is equal to "Streaky Current" Manila Hemp. Cleaning "Good"; texture "Medium"; length "Normal".

6. Sample from British North Borneo. Labelled D. Received March 1925. Extracted from leaf stalks near the centre of the stem. Colour equal to "Superior Current" Manila Hemp; cleaning "Good"; texture "Soft"; and length "Normal".

7. Sample from the Government Experimental Plantation, Serdang, F.M.S. Prepared 22nd. January, 1925. Colour equal to "Current" Manila Hemp, cleaning "Good", texture "Medium" and length "Normal."

8. Sample from Government Experimental Plantation, Serdang, F.M.S. Prepared 3rd February, 1925. Colour equal to "Streaky Current" Manila Hemp, cleaning "Good"; texture "Medium"; and length "Normal."

9. Sample "A" from Government Experimental Plantation, Serdang, F.M.S. Prepared 30th March, 1925, colour equal to "Current" Manila Hemp, cleaning "Good"; texture "Medium"; and length "Short."

10. Sample "B" from Government Experimental Plantation, Serdang, F.M.S., prepared 30th March, 1925. Colour equal to "Superior Current" Manila Hemp, cleaning "Good"; texture "Soft"; length "Short."

TABLE I.

Tensile strength Determinations carried out at the Department of Agriculture, F. M. S.

Sample.	Description.	Number of tests.	Average weight of Sample grms.	Mean breaking load. Kgs.	Mean Tensile Strength Kgs. per unit grm. metre.	Standard deviation. ± —
1	Manila "Extra Prime" Government Standard --	10	0.3929	18.0	46.1	5.1
2	Manila "Superior Current" Government Standard -	10	0.5171	20.1	40.05	6.3
3	Manila "Good Current" Government Standard -	10	0.6270	27.2	42 3	2.63
4	British North Borneo "B" -	12	0.5369	29.36	54.41	9.25
5	British North Borneo "C"	12	0.5944	30.78	51.45	7.7
6	British North Borneo "D"	12	0.5117	21.17	41.27	7.2
7	Gov. Expt. Plantation, Serdang Jan. 30th 1925 -	20	0.6109	23.25	38.14	9.07
8	Govt. Expt. Plantation, Serdang, Feb. 3rd 1925 -	16	0.6806	26.04	38.79	5.69
9	Govt. Expt. Plantation Serdang Mar. 3rd 1925 "A"	10	0.6148	27.6	45.0	3.38
10	Govt. Expt. Plantation Serdang, Mar. 3rd 1925 "B"	10	0.7136	27.98	38.98	3.21

The determinations of tensile strength were caried out on a Schopper Testing Machine in accordance with the procedure standardised by the U. S. A. Bureau of Standards. The samples of fibre were selected, their length measured, and then weighed on an analytical balance. Each sample consisted of twenty single fibres, the breaking load was determined at each end and in the middle of each sample. The testing length, that is, the distance between the fixed jaws of the machine at the commencement of the application of the load was twenty centimetres.

The average of the three breaks gives the breaking load for one sample. The breaking load divided by the average weight per metre gives the tensile strength per unit gramme metre.

In weighing the samples care was taken to standardise the conditions governing the moisture content of the fibre under examination. The results recorded in Table I were obtained on samples of fibre having an average moisture content of 12 per cent.*

Chemical Examination of Manila Hemp.—For purposes of comparison the standard samples of fibre obtained from the Philippine Islands were subjected to a chemical examination in accordance with the procedure standardised by Cross and Bevan and adopted by the Imperial Institute.

The results are recorded with those obtained from examinations of two samples of fibre produced in British North Borneo and two samples of fibre produced from the Government Experimental Plantation, Serdang. (See Table II overpage).

Conclusions.—Consideration of these results leads to the conclusion, that pending further experimental work, it is not yet possible to advocate the cultivation of *Musa textilis* as a commercial proposition in Malaya. It is evident that the initial work has not resulted in the production of a fibre as good as that obtained in British North Borneo, which again is inferior to the "Prime" Abaca produced in the Philippine Islands. The size of the plants grown at Serdang, compared with plants grown in the Philippines necessitate the handling of plants on a much larger scale than hitherto before any conclusions can be arrived at as to the economic possibilities of the local product.

In conclusion the authors beg to acknowledge the receipt of samples and information provided by the Director of Agriculture, British North Borneo and the Director of Agriculture, Philippine Islands. Thanks are also due to Mr. Gunn Lay Teck, Assistant Analyst, Department of Agriculture, F.M.S. & S.S. for assistance in carrying out some of the chemical analyses, and to the Fibre Committee, Department of Agriculture, F.M.S. & S.S. for assistance in connection with the publication of these notes.

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*This may account for the difference in tensile strength of standard Manila Hemp tested in the F.M.S. and elsewhere. Our results are uniformly lower than those recorded by the U.S.A Bureau of Standards, Washington. No figures are available to show the humidity in the latter case.

TABLE II.

Results of Chemical Examination of Manila Hemp.

Sample.	Moisture.	Results calculated on the "Moisture-Free" Sample.					
		Ash.	Loss on washing with water.	Loss on washing with acid.	Hydrolysis "A" Loss.	Hydrolysis "B" Loss.	Cellulose content.
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
1. Grade A. Extra Prime Manila ...	9.70	1.20	0.17	0.55	12.62	17.61	76.66
2. Grade F. Current Manila ...	11.03	1.35	0.06	0.62	11.86	15.46	76.76
3. Grade 1. Good Fair Manila ...	11.45	1.69	2.59	3.16	15.53	21.83	74.08
4. Grade V². Fair No. 1 Manila ...	12.00	4.20	8.24	8.52	18.75	29.32	62.77
5. B. N. B. received May, 1924 ...	14.08	2.01	trace	trace	12.24	16.13	78.40
6. B. N. B. received March, 1925. Sample "C"	10.00	1.82	trace	1.40	14.70	16.00	77.40
7. B. N. B. received March, 1925. Sample "D"	12.00	1.96	trace	2.67	15.30	17.3	75.20
8. Serdang Fibre received March 1925.	13.9	2.33	trace	5.06	14.8	16.2	73.5

Received for publication 1st May, 1925.

A PRELIMINARY NOTE ON A PHYTOPHTHORA ASSOCIATED WITH PATCH CANKER OF HEVEA BRASILIENSIS IN MALAYA.

By A. Thompson.

PATCH CANKER of *Hevea brasiliensis* has, up to the present, been attributed to the fungus *Phytophthora faberi* (Maubl). Petch (1) in Ceylon, and Rutgers (2) in Java have proved that the disease can be produced on *Hevea brasiliensis* if the bark is inoculated with *Phytophthora faberi*. Both these investigators used *Phytophthora faberi* isolated originally from Cacao or Nutmeg, but, as far as available literature shows, no investigator has originally isolated *Phytophthora faberi* from Patch Canker of Hevea. In November 1924 some cases of a disease on Hevea came under observation and the writer was successful in isolating a fungus from the diseased tissues. The symptoms of the disease resembled those of Claret-coloured Canker, although a claret coloured patch was only seen in one instance. The fungus is considered to be a *Phytophthora* with a method of liberating zoospores closely resembling that found in the genus *Pythium*. No other method of zoospore production has been observed.

The fungus differs from *Phytophthora faberi* not only in this particular, but also in the growth of large numbers of oogonia and antheridia in pure culture, and in the size of sporangia and oogonia. Maize agar, Potato agar and Lima bean agar are suitable media for the growth of the fungus. Sporangia, chlamydospores, oospores and antheridia appear freely on all these media. Details of attachment of the antheridium to the oogonium have not yet been definitely determined. The diameter of the oospores is from 14—19 microns with a mean diameter of 16.7 microns. The sporangia are mostly spherical and on Potato agar measure from 16—24 microns × 15—23 microns with a mean length of 19.9 microns and a mean width of 18.6 microns. These figures are much smaller than those obtained for *Phytophthora faberi*. The apical papilla is not as a rule seen until the sporangia are placed in water and zoospore formation begins. In the majority of cases observed the procedure is as follows:—The papilla grows out into a tube which may be as long as the length of the sporangium. The contents of the sporangium flow out through this tube and form a vesicle attached to the tube. This is usually complete about 10 minutes after the tube has begun to grow. As soon as the contents of the sporangium are contained in the vesicle the latter, which is roughly spherical, becomes slightly agitated and the protoplasm splits up into zoospores. This usually takes 5 minutes and meanwhile the agitation of the vesicle increases until it is jerking about vigorously in the water. The zoospores then separate and for a few seconds swim about inside the vesicle, which finally ruptures at one side and the zoospores escape quickly. In twelve observations made the process took from 20—25 minutes from the first appearance of the papilla to the final rupture of the vesicle. The zoospores come

to rest after an hour or an hour and a half, round off, and germinate, usually by a single germ tube.

Successful preliminary inoculation experiments on Hevea have been carried out and the fungus again recovered from the inoculated trees. The method of inoculation was as follows :—

(1) About ¼ in. square of virgin bark was lightly scraped on 6 trees and mycelium of the fungus applied, a piece of sterilised cotton-wool was fixed over the inoculation with plastascine and kept moist as the weather was dry. After 14 days the inoculations were examined and it was found that on all the inoculated trees the bark round the inoculation was discoloured greyish black and dead with lateral extension of about 1½ ins. on each side of the inoculation. After a month the patches were about 3½ inches in diameter and had penetrated in as far as the laticiferous layer. Controls remained normal.

(2) A watch glass was cemented with plasticine on the virgin bark just below a tapping cut of a tree in tapping. The top of the glass was not cemented and through this opening a suspension of zoospores in water was poured. The water almost filled up the cup formed by the watch glass. This was left on the tree for four days and then removed. Three weeks later, on removing the scrap, a dark brown line was seen on the tapping cut. This line was about half a millimeter in width and about 3½ inches long. It had not spread in to involve many of the latex rings and latex was still obtainable from the cut. After another week the bark below the cut was scraped and found to be diseased in a patch of about 4 inches in diameter. The bark was moist and of a purplish colour. A similar inoculation using water only gave no result.

From the above inoculations it would appear that this fungus, which is not *Phytophthora faberi*, is the cause of Patch Canker of Hevea in Malaya. Both Petch and Rutgers base their conclusion that *Phytophthora faberi* is the cause of Patch Canker of Hevea on the facts obtained by inoculations with *Phytophthora faberi* isolated from Cacao and Nutmeg.

It seems probable that, in mixed Cacao and Hevea areas, where the Cacao is attacked by *Phytophthora faberi*, this fungus would be responsible for the canker in Hevea. In view of the results obtained above, however, it would be desirable to have the cause of Patch Canker of Hevea definitely proved in Ceylon and Java by isolating a fungus from Hevea Canker and proving it to be the cause of the disease by inoculations. If the fungus proves to be *Phytophthora faberi* the position is then established as regards the disease in the two countries mentioned.

In a report to the Brown Bast Investigation Committee in 1918 Mr. R. M. Richards, Mycologist to the Malay Peninsula Agricultural Association, reports having isolated a *Phytophthora* from Patch Canker of *Hevea* and by inoculations reproduced the disease. He considers the fungus to be a species of *Phytophthora* as yet unnamed.

The writer has been unable to obtain further information on this fungus, owing to Mr. Richard's absence from Malaya, but it seems probable that the two fungi isolated in Malaya will prove to be identical.

References.

(1) Petch T. Cacao and Hevea Canker. Cirs. and Agr. Journ. R. B. G. Ceylon V. No. 13, 1910.

(2) Rutgers A. A. L. Hevea Kanker iii Med. van het Lab. v Plant. No. 28, 1917.

Received for publication 17*th April* 1925.

TRACTOR PLOUGHING FOR PADI CULTIVATION.

By H. W. Jack.

THE methods employed by Malays in the cultivation of padi are frequently criticised as wasteful, laborious and antiquated, but the more such methods are studied the more will the student realise that they have been evolved from long years of practical experience and that many practices in vogue are not so 'ridiculous' as may appear on first consideration.

The critic is generally unacquainted with the real conditions under which padi cultivation can be carried on successfully and frequently forgets the important facts that the industry is entirely conducted by small holders and that they have little or no capital.

Rarely can good padi land be found which is uniform in respect of soil texture and composition and free from soft pockets which may result from the removal of jungle stumps or may mark previous slimy wallowing pits of the padi buffalo or denote abandoned wells.

Further; the nature of a padi area frequently necessitates terracing to such an extent that the unit area is reduced to a very small block which has to be bounded by a 'batas' or bund in order to hold up the water supply, so essential for the production of profitable crops. Moreover, cultivation is always carried on under wet weather conditions. All these factors bear a highly significant relation to methods of padi cultivation which, with long practice, have become customary, and the poverty of the cultivators certainly militates against the operation of some of the more modern forms of cultivation, such as tractor ploughing, at any rate until native agriculture becomes more organised.

The practices which are most subject to criticism are those of ploughing the land and harvesting the crop, and this note is intended to portray briefly the relative merits of buffalo ploughing in contrast to ploughing by tractor in the light of existing conditions of rice growing.

The tillage of land for the cultivation of padi is entirely performed by so-called 'antiquated' methods which have been described in the Malayan Agricultural Journal, Vol XI, No. 5, 1923.

The native plough is a much malinged implement and is wrongly held responsible by critics for unsatisfactory padi crops. True, the soil is often far too scantily tilled but this is no fault of the plough—the cultivators may not incline to industrious labour or there may be shortage of buffaloes or each man may be attempting more than he can cope with thoroughly or the rains which soften the soil may be late.

The native plough is simple in construction, light, and of easy draught and shaped for shallow work which is all that is required for

the rice plant. Tractors are cumbrous in the padi fields, complicated in construction, costly to purchase, expensive to work on small areas, require constant supervision and are apt to dig themselves in whenever they strike a soft pocket of soil, still they have useful points in their favour in being able to furrow and turn hard soil and to work more rapidly than the buffalo.

On the opening of a new padi experiment station at Pulau Gadong in Malacca in 1922 the land selected was hard and had been under lalang for at least 10 years and thus offered a good test for tractor ploughing.

In 1922 a block of 5 acres was ploughed and harrowed with a Fordson tractor, thanks to Messrs. Wearne Bros., Ltd., who kindly offered to do the ploughing, free of cost, as a demonstration. While the 'Fordson' ploughed the land well—in fact too well, the furrow being rather too deep for the first season's growth of padi on previously untilled land—the work proved much more costly than was anticipated, though the condition of the land was somewhat adverse and the driver was unaccustomed to ploughing. The land was ploughed at the rate of 2.9 acres per day of eight hours at the calculated cost of $11.50 per acre. The slow working was mainly due to the inexperience of the driver in the handling of the machine, particularly the plough, coupled with the rough nature of the soil which was packed with lalang roots and the smallness of the land divisions necessitating frequent turnings which cost fuel and wasted time.

According to Mr. Fairweather (the Field Officer who conducted all the trials) subsequent ploughings could probably have been done at a cost of $8/- to $9/- per acre and at an increased rate, especially if the driver in the meantime gained more experience in handling the plough, and considering that occasional obstructions had been removed during the first ploughing.

The calculated cost of harrowing and cross harrowing, that is, two harrowings, was $2.30 per acre, so that if $8.50 be regarded as the cost of ploughing previous tilled land, the cost of preparing the land for planting should be less than $11 00 per acre, to which must be added the expense of making batas and the establishment of nurseries.

Some 7 acres of additional new land were ploughed in 1923 using a caterpiller type of tractor—the Cletrac—kindly lent by the Agriculturist for the occasion. This tractor proved very troublesome at first but with a change of driver did very good good work except when soft pockets were encountered when it dug itself in just as effectually as did the 'Fordson.'

Ploughing and harrowing costs with the 'Cletrac' were much the same as in the case of the 'Fordson,'-though actual figures are not available. The 'Cletrac' disc harrowed land which had been ploughed the previous season at the rate of an acre per hour.

Of course, these tractor working costs do not include cost of machinery or its transport or interest on capital or depreciation or

supervision, all items which would very appreciably increase the working cost particularly on a small area.

In contrast, buffalo ploughing costs in Malacca have been worked out by Mr. Fairweather at $2.50 per acre including depreciation of buffalo and implements, (though contractors always want $8/- to $10/- per acre) and harrowing and rolling each at about the same rate as ploughing. While costs of Malay labour and assessment of depreciation on buffalo and implements are difficult to calculate, the work of ploughing takes a Malay 5-6 days, harrowing 3 days, and rolling 1-2 days, or in all 9-11 days labour per acre.

Malay contract rates for ploughing, harrowing and rolling take no cognisance of the arduousness of the buffalo's task but are merely based on the number of days' work each operation is likely to take and hence their complete contract rates for preparing the land vary between $16/- and $23/- per acre, whereas all these operations have been accomplished, using Departmental buffaloes and paying wages at the rate of 50 cents per day of 5 hours, at a cost of $5/- (exclusive of cost of upkeep of buffaloes). From the Malay standpoint the depreciation and upkeep expenses of keeping a buffalo are immaterial, as is depreciation of implements which they usually fashion themselves and which often last a very long time.

Thus the preparation of land for padi planting using buffalo power costs about $5/- per acre if the cultivator owns his own buffalo, and if he has to rent a buffalo (the rent may amount to $3/- or $4/-) about $9/- per acre, whereas using tractor power the same work costs $11/- per acre, without allowing for any but actual running costs.

Hence the economy and suitability of using buffalo in preference to mechanical power, under existing conditions of padi cultivation, is very apparent.

Tractors may have a future in padi cultivation on large areas where the soils are fairly hard and where irrigation is controlled, especially for harvesting purposes, but they are essentially implements for use on large areas and are only available to capitalists, and as such their adoption is very remote even if co-operation should succeed in overcoming the existing poverty of the average padi planter.

Much of the information on which these brief notes are based is obtained from the files of the Chief Field Officer, to whom thanks are tendered.

Received for publication 20*th April* 1925.

MANURING OF HEVEA BRASILIENSIS.

By F. G. Spring.

EXPERIMENTS on the manuring of Hevea have been conducted in Ceylon, Malaya, South India and Sumatra, but the results obtained do not indicate that the application of artificial fertilizers will be an economic proposition in respect of increased yields of latex, except in certain circumstances.

Most Malayan rubber estates have been opened up from areas which have been under virgin jungle for generations and the fertility should be maintained under rubber cultivation without having to resort to fertilizers if precautions are taken to conserve the surface soil. The plantation rubber industry is of recent origin consequently such land has been in cultivation for a few years only. There are exceptions in which rubber cultivation has succeeded other crops such as coffee, gambier, pepper, pineapples, sugar or tapioca ; the soils on such areas were partly exhausted previous to the planting of rubber, chiefly owing to the loss of surface soil caused by lack of suitable methods of conservation. It is probable that the average soils in Malaya are sufficiently fertile to maintain good growth and yields of rubber for many years and that we have not yet reached the stage of diminishing returns. If this is so, it is not surprising that manurial experiments have given indefinite results. On the poorer types of soil, however, it is reasonable to suppose that increased yield would be derived from the application of artificial fertilizers. A system of manuring for annual crops is more easily determined than for permanent crops, particularly in the case of the rubber tree. The effects of the application to soils of fertilizers containing certain plant foods on the yield of fruit, grain, or roots are known, in the case of soils deficient in in such constituents, but the influence of such constituents on yield of latex, the significance of which in the metabolism of the tree require further investigation, is still problematical. It is generally agreed that the rubber tree does respond to manuring in respect of growth and foliage, but little information is available as regards the effect on the yield of rubber. Assuming that there is no appreciable increase in yield in the beginning, this is no proof that the continued application of fertilizers would not ultimately be responsible for an increase in crop. If there is a continued falling off in yields from good land, it is very necessary to search carefully for causes before resorting to the use of fertilizers. Previous H. A. P. M. experiments on six to eight year old rubber indicated no beneficial results from cultivation experiments. Except on certain soils, in which the addition of lime improves the physical character of the soil, or with the object of encouraging the growth of leguminous cover crops, it is questionable whether the rubber tree responds to liming. A normal acid soil may suit the rubber tree.

The high temperature, humidity and large annual rainfall in Malaya cause more rapid decomposition of the soil than occurs in

temperate zones, rendering plant food more rapidly available. Manurial experiments on the rubber tree require special consideration since there are so may factors which may influence the yield that it is difficult to plan field experiments which will reduce the experimental error to a minimum. Factors to be considered are, size and number of plots, variations in the soil, tapping system and quality of tapping, uniformity in growth, distance of planting and variation in individual yield of trees.

Preliminary records of yields in the various plots require to be taken previous to the application of manures when experimenting with mature rubber trees. The chemical analysis of a soil is a guide to manuring but it should be considered in conjunction with other factors. The result of the experiment should be judged by yield, girth, examination of bark, foliage, resistance to disease and the general appearance of the trees. Yield is the all important object to be attained, but it is wise to record other observations as they may be responsible for enabling definite conclusions to be recorded in later years. Although with our present knowledge the use of artificial manures on average land cannot be recommended as a general practice, there is no reason why experiments should not be carried out in order to gain more information. A single test is only of value in relation to the particular type of soil on which the experiment is conducted. A series of trials, conducted on different soils, in a scientific manner, in various parts of the country is required.

The trees which are most likely to be benefitted by manures are those growing on (1) light soils deficient in humus, (2) sandy soils, (3) poor laterite soils, (4) soils which have been under long cultivation previous to the planting of rubber, and (5) soils such as those described in the experiments carried out in Sumatra in which the absence of ammonification and nitrification was recorded.

If any estate manager contemplates manurial work it is advisable that he should consult the Department of Agriculture in regard to the planning of field experiments. It might here be mentioned that practically most fertilizers are now obtainable in this country or from India.

The question of green manuring is not discussed in this paper, since it is proposed to deal with this subject in a later article.

It will be of interest to review briefly some of the previous work on the manuring of Hevea but no assurance can be given that the results in other countries will be obtained in Malaya since conditions may differ particularly in respect of humidity, rainfall and soil.

Anstead (1) reports that the result of practically all such experiments so far conducted has been that unmanured plots give quite as good yields as manured plots.

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(1) Manuring of Hevea brasiliensis. R. D. Anstead, The Agricultural Journal of India, Vol. XIII, 1918, page 660.

Bryce and Gadd(2) writing on this subject state that, of the many manurial experiments carried out on rubber, no one experiment, to their knowledge, has indubitably proved that the application of manures has increased the yield of rubber. They state that the application of manure increase the growth and general vigour of the trees, since it is possible to distinguish manured from unmanured fields by their general appearance.

An experiment conducted by Spring(3) showed that over a period of four years (two applications of manure) the total increases of girth in the manured plots in every case, exceed that of the controls.

The latest results reported by Grantham(4) are of special interest. The experiments were carried out on the soils of the H.A.P.M., viz., the red liparite tuff sedentary soil and on the various types of white alluvial soil. Grantham's summary of his results is as follows:

The white soils responded remarkably to the application of sodium nitrate, calcium nitrate and ammonium sulphate and the typical deterioration characteristic of the older rubber on these soils was arrested. By repeated applications, the trees were improved until they equalled the trees on the good red soil in yield and appearance. The effect on the bark renewal was also pronounced and to this is probably to be attributed the fact that a single application produces a more prolonged effect on yield than on appearance. Sodium nitrate gave no effect on the red soil.

The use of basic slag (Thomas phosphate), potassium cloride and lime was without effect on the white soil or on the red soil. Superphosphate was actually harmful, probably owing to its acidity.

Green manuring with mimosa was also without appreciable result on the white soils.

Attention must be directed to the fact that the results described above have been obtained on the special soil types peculiar to a part of the East Coast of Sumatra, and it by no means follows that similar results will be obtained on other soil types. It is necessary to carry out field experiments on each characteristic soil type, before proceeding to practical manuring.

Grantham in his general discussion of the results reports:—"It is evident that the deterioration which normally results from the more intense competition for nutriment in the older rubber on the white soils is entirely due to one factor, viz. nitrogen starvation. Once this

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(2) Department of Agriculture, Ceylon, Bulletin No. 68, page 70. Yield and Growth in Hevea brasiliensis. G. Bryce and C. H. Gadd.

(3) Manurial Experiments with Young Rubber at Kuala Lumpur. Agricultural Bulletin, F. M. S. Vol IV, No. 4, page 105. F. G. Spring.

(4) Manurial Experiments on Hevea. Archief, Jaargang No. 8 Augustus 1924, page 501. J. Grantham.

deficiency has been satisfied by the application of an available form of nitrogen, the growth and yield of rubber becomes fully equal to that on the red soil. If it is not satisfied deterioration is progressive. One application of nitrate is sufficient to arrest the deterioration for 3 or 4 years but, for actual improvement, applications at shorter intervals are necessary. It is probable that the most economic result is obtained by the application of 5 lbs. of sodium nitrate or 4 lbs. of ammonium sulphate per tree once in two years, although yearly application may attain the maximum result more quickly. So far no deterimental effects on the soil have been noted from intensive manuring over 5 years.

The reason why nitrogen starvation occurs in the white soils is not entirely clear but it is probably connected with the low bacterial activity of the soils as regards ammonification, nitrification and nitrogen fixing. It is also probable that this low bacterial activity is responsible for the failure of green manuring to produce results. Green manures certainly form nodules (many more on the second crop than on the first) but the nitrogen fixed presumably does not become converted to an available form. The impermeable nature of much of the surface soil and of practically all the subsoil, due to this colloidal content, produces conditions more favourable to de-nitrification than to nitrification. Where nitrification is good, as in the low peaty clay soil, there is no nitrogen starvation. The case of the red soil is somewhat anomalous as it also has a low bacterial activity, but there is a much greater volume of soil available and the root system is so much better developed owing to the absence of any impermeable subsoil or high ground water level that the tree is probably able to obtain a sufficient quantity of nitrogen. Certainly there is no nitrogen starvation or other deficiency on the red soil."

Received for publication 31*st March*, 1925.

NOTES.

(*a*) Despatch of Rubber Samples to the Department of Agriculture for Examination.

The attention of managers of estates and others who send samples of rubber to the Department for examination is directed to the following Gazette Notification—F.M.S. Government Gazette Vol. XVI No. 26 of 12th December, 1924, page 2360, Notification No. 8538 which reads as follows :—

In exercise of the powers vested in him by section 17 of "The Customs Enactment, 1923", The Chief Secretary to Government hereby prohibits the importation of unvulcanised rubber into the Federated Malay States with effect from the date of this notification.

This prohibition shall not apply to—

(*d*) Samples of unvulcanised rubber not exceeding 11 pounds in weight sent by parcel post and marked "Rubber Samples."

(*b*) Rubber Loop Shock Absorbers.

A useful new application of rubber described in "The Rubber Age" (U. S. A) Vol. XVI No. 10/1925 is a shock absorber which consists of a band of rubber about 3 inches wide and ½ inch thick. The length of the strip will depend on the clearance between the frame of the chassis and the axle. The strip is looped under the axle and the ends are attached by means of a clamp to the frame of the chassis.

These absorbers are stated to be the least expensive spring checking device on the market. The manufactured straps are specially compounded and will stand a pulling strain of 4000 lbs per square inch. and the shock absorber is stated to have great wearing qualities. This device is made in the United States of America and is stated to have been on the market for eighteen months.

A similar device has been made by Mr. Wilkinson in Malaya using rubber prepared by his process, which should prove very useful and effective.

B. J. E.

Publications of the Department of Agriculture.

The following publications, except those out of print, may be obtained on application to the Office of the Secretary for Agriculture: and the Malay States Information Agency, 88, Cannon Street, E.C. London.

A remittance to cover the cost should accompany applications; otherwise the Journals will be sent by post, Cash on Delivery, where that system is in force.

1. The Agricultural Bulletin F.M.S.

Vols. I—IV (1913-16) VIII & IX (1920-21) price $5.00 per volume.
Vol. V (1917) Nos. 1, 2, 3, 5 & 6 „ 2.50 per set.
„ VI (1918) „ 1, 7, 8 & 12 „ 2.00 „
„ VII (1919) „ 2—6 „ 4.50 „

2. The Malayan Agricultural Journal (continuing the Agricultural Bulletin). Published monthly.

Vol. X (1922) Price $5.00 per volume.
„ XI (1923) Price $5.00 per volume or 50 cents per single number.
„ XII (1924) „ „ „ „

Back numbers of Vols. I—X will not be sold singly.

3. The Handbook of Malayan Agriculture, price $1.00.

Current numbers of the Malayan Agricultural Journal and the Handbook may be purchased at the Railway Bookstalls and Branches of Messrs. The Federal Rubber Stamp Co.

4. *Special Bulletins.*

1. Notes on *Termes Gestroi* and other species of Termites found on Rubber Estates in the Federated Malay States, by H. C. Pratt, Government Entomologist, 1909, 20 cts.
2. Root Diseases of *Hevea Brasiliensis*, by W. J. Gallagher. C
3. Observations on *Termes Gestroi* as affecting the Para Rubber Tree and methods to be employed against its Ravages, by H. C. Pratt, Government Entomologist, 1910, reprint 1916, 20 cts. (Out of Print.)
4. A Lepidopterous Pest of Coconuts, *Brachartona catoxantha, Hamps*, by H. C. Pratt, 1909. C
5. The Extermination of Rats in Rice Fields, by W. J. Gallagher, 1909. C
6. Preliminary note on a Branch and Stem Disease of *Hevea Brasilienisis*, by W. J. Gallagher, 1909. C
7. Coffea Robusta, by W. J. Gallagher, Government Mycologist, 1910, 20 cts.
8. The Cultivation and Care of the Para Rubber Tree (in Malay) 1910. C
9. Die-Back Fungus of Para Rubber and of Cacao, by K. Bancroft, 1911. C
10. A Lecture on the Para Rubber Tree, by W. J. Gallagher, 1910. C
11. Coconut Cultivation, by L. C. Brown, 1911. C
12. Padi Cultivation in Krian, by H. C. Pratt, 1911. C
13. A Root Disease of Para Rubber, *Fomes Semitostus*, by K. Bancroft, Assistant Mycologist 1912, 20 cts.

C = Cancelled